

# Economic Growth: Growth Education and Human Capital

EC307 ECONOMIC DEVELOPMENT

Dr. Kumar Aniket  
University of Cambridge & LSE Summer School

Lecture 5  
created on July 5, 2009

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## READINGS

Tables and figures in this lecture are taken from:

- Chapters 4 & 5 of Ray (1998)
- Galor, O. and Zeira, J. (1993). Income Distribution and Macroeconomics. Review of Economic Studies.
- Romer, P. (1994). The Origins of Endogenous Growth. The Journal of Economic Perspectives 8 (1): 23–44.
- Grossman, G.M. and Helpman, E. (1994). Endogenous Innovation in the Theory of Growth. The Journal of Economic Perspectives 8 (1): 23–44.
- ▶ **Class based on** Jones, B. & Olken, B. (2005). Do Leaders Matter? National Leadership and Growth since WW2. Quarterly Journal of Economics

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## CONVERGENCE

- Neo-classical Assumptions dropped in Endogenous Growth model due to failure of cross-country convergence
  1. Technological Change is exogenous
  2. Similar technological opportunities are available everywhere
- Endogenous Growth emphasises that Economic Growth is an *endogenous* outcome of an economic system, not the result of forces that either drive the changes or impinge the economic system from outside
- **External Aid:** inconclusive literature on Foreign Aid
- **FDI:** Literature on FDI more positive

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## THE CONVERGENCE CONTROVERSY

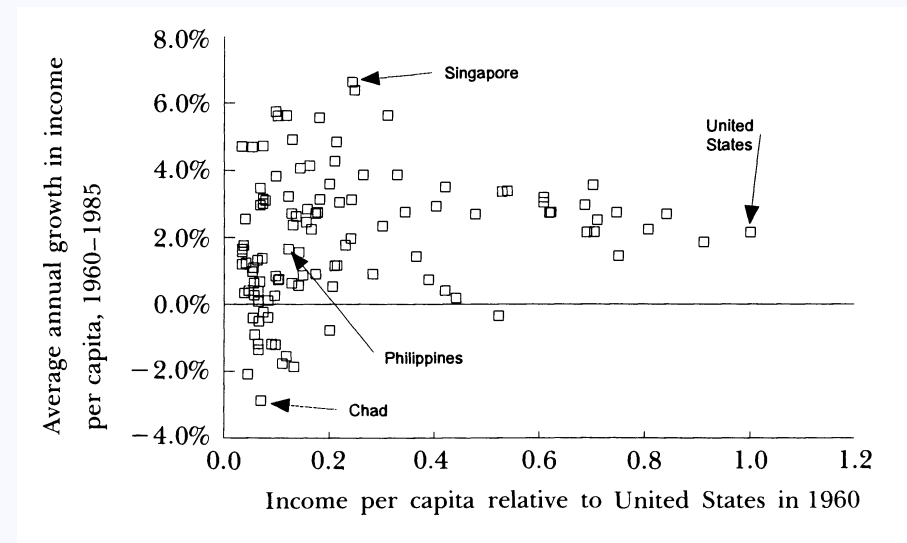
- Heston Summer Data Set: Broad Sample of countries in the data set
  - Average per capita growth of income per capita 1960-1985
  - versus
  - Income per Capita in 1960
- Why aren't poor countries catching up like the low income US states catch with high income states?

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### Average Annual Income Growth versus Income per capita relative to US in 1960

- Does distance from US in 1960 predict annual growth since then
- No discernible trend

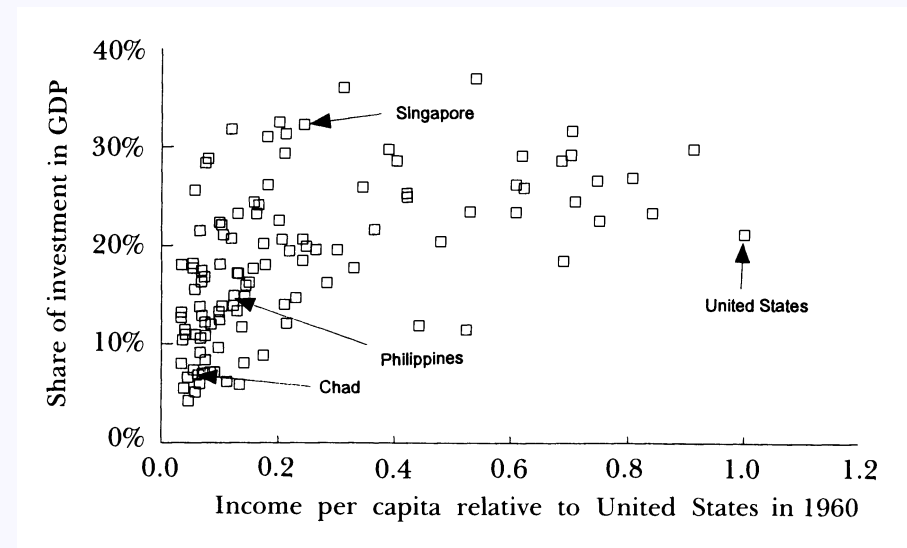
### LOOKING FOR CONVERGENCE



### Investment rate versus Level of per capita investment

- Higher income is associated with higher investment rate
- Magnitude of differences too small

### PER CAPITA INCOME AND INVESTMENT



## DISCARDING THE NEO-CLASSICAL MODEL

- Require a model where diminishing returns to capital accumulation set in more slowly
- Arrow (1962) knowledge **spillover effects** from capital investment
- Romer (1987) uses the **spillover effects**
  - A determined locally by knowledge spillovers
  - capital investment increase the level of technology for *all* firms in the economy

## PUBLIC GOOD

- Non-rivalrous and Excludability

	Rivalrous Goods	Non-rivalrous Goods
High	Lawyer Services	Encoded Satellite TV
↑	CD Player	Computer Code
↑	Floppy Disks	Tesco Operation Manuals
Excludability		National Defense
↓		Basic R&D
↓	Sterile insects	Calculus
Low		

## FACTS ABOUT FIRMS AND MARKETS IN ECONOMY

- Fact 1:* There are many firms in the market economy
- Fact 2:* Discoveries differs from other inputs – many people can use them at the same time
- Ordinary goods are rival goods but information is a non-rival good

## FACTS ABOUT FIRMS AND MARKETS IN ECONOMY

- Fact 3:* It is possible to replicate physical activities
- A is **non-rival**
  - Double the physical inputs but there is no reason to double A
  - Euler Theorem (CRS)<sup>1</sup> implies output divided up amongst the rival inputs
  - nothing left to compensate non-rival input, e.g. researchers

# FACTS ABOUT FIRMS AND MARKETS IN ECONOMY

- Fact 4:* Technological advances come from what people do
- Discoveries: Exogenous or random in nature
  - Each discovery may be random but rate of discoveries is based on random chance and is not an exogenous. Research effort influences the randomness and makes discoveries it more likely.
- Fact 5:* Many individuals and firms have market power and earn monopoly rents on discoveries
- Information from discoveries maybe non-rival but they themselves are **excludable**
    - o patents
    - o The coke story
  - Monopolistic Competition

# FACTS AND MODELS

## Neo-classical Growth Models

- Considered *Facts 1,2 & 3* ... *treats technology as a public good*
  - Non Rival
  - Excludable
- ... but postponed *Fact 4 & 5*
  - discoveries are excludable

# FACTS AND MODELS

## Endogenous Growth Models

- o Shell (1966): In a competitive setup, no resource left over to pay for advances in *A*
  - *A* financed from tax revenue
- o Arrow (1962): emphasize the role of private sector rather than public sector in the advance of technology
- o Neo-Schumpeter models: incorporate Fact 4 (technological advances come from what people do) & Fact 5 (monopoly rents)
  - Schumpeter emphasised the importance of *temporary monopoly powers* as a motivating force in the innovative process
- o Spillover models: (Romer, 1986) etc.

# EARLY ENDOGENOUS GROWTH MODELS

- o Both Romer (1986) & Lucas (1988) took *Fact 4* but not *Fact 5* into account
  - technology advances result of private investment
  - firms are price takers ⇒ many firms could exist
- o Lucas (1988): Investment in human capital has a spill-over effects that lead to increase in technology
- o Romer (1986): Investment in physical capital has a spill-over effects that lead to increase in technology

## GROWTH AND INEQUALITY

- Letting people have non-identical endowments allows us to explore effects of income and wealth inequality on growth
- *Conventional Wisdom*: Income inequality is good for *incentives* and thus should be good for growth – Rebelo (1991)
- Extracting the rents accumulated by the innovators should have a negative effect on growth

## INVERTED U HYPOTHESIS

- Kuznets theory: transition from *traditional* or *rural* economy towards *industrial/urban* economy (with higher wages)
  1. The distribution of income *widens* in the early stages of development
    - Very few individuals have the required ability or human capital to move to the industrial sector
  2. The distribution of income should *narrow* in the latter stages of development
    - 2.1 As more people are absorbed by the industrial sector
    - 2.2 Wages in the rural sector catch up with the wages in the industrial sector due to the scarcity of agricultural workers

## INTERGENERATIONAL TRANSFER OF WEALTH

### Human Capital:

Individuals save in two distinct forms

- Save in physical capital
- Save by investing in education / human capital
  - increases the market value of labour supply in the future benefits the household directly or
  - altruistic parents invest into the education of their children

## GROWTH AND INCOME DISTRIBUTION

Galor and Zeria examine the linkages between *income distribution* and *growth* by exploring the *human capital investment* channel.

2 sectors: one that employs skilled labour and capital and the other that only employs unskilled labour.

- Reminiscent of the Formal and Informal Sectors

Skilled sector's CRS production function

$$Y^s = F(K_t, L_t^s)$$

The unskilled sector's production Function

$$Y^n = w_n L_t^n$$

	Skilled Sector	Unskilled Sector
Labour in sectors	$L^s$	$L^n$
Output	$Y^s = F(K, L^s)$	$Y^n = w_n L^n$
Return to labour	$w_s = F_L(K, L^s)$	$w_n$
Return to capital	$r = F_K(K, L^s)$	-

A worker needs to make an indivisible investment of  $h$  to acquire the *human capital* required to work in the *skilled sector*.

Complementarity between *skilled labour* and *capital* but no complementarity between *unskilled labour* and *capital*.

## CONSUMPTION AND BEQUESTS

Individuals live for two periods where

they can either work as unskilled labour in both periods or invest in human capital in the first period and work as skilled labour in the second period.

- If they work as unskilled labour, they earn  $w_n$  in each period.
- If they invest  $h$  into human capital in the first period, they can earn  $w_s$  in the second period.

The indivisibility of investment in human capital implies that there increasing returns to scale.

## CONSUMPTION AND BEQUESTS

- Each individual has one parent and one child creating the connection between generations within dynasties and implying that there is no population growth.
- Individuals consume only in their second period of their life and derive pleasure out of leaving a bequest to their children.

The individual utility from consumption  $c$  and bequest  $x$  to the next generation is given by:

$$u = \alpha \log(c) + (1 - \alpha) \log(b)$$

## CONSUMPTION AND BEQUESTS

We find that their consumption and bequest are given by

$$c = \alpha m$$

$$b = (1 - \alpha)m$$

where  $m$  is the individual's lifetime income.

- The individual consume  $\alpha$  and bequest  $(1 - \alpha)$  proportion of  $m$ , their lifetime income.

# CONSUMPTION AND BEQUESTS

Langrangian that maximises the utility  $u$  subject to the inter-temporal budget constraint  $c + x = m$ .

$$\ell = \alpha \log(c) + (1 - \alpha) \log(b) + \lambda [m - c - b]$$

FOCs:  $\frac{c}{\alpha} = \frac{b}{1 - \alpha} = \frac{1}{\lambda} = m$

$$\Rightarrow u = \log(m) + [\alpha \log(\alpha) + (1 - \alpha) \log(1 - \alpha)]$$

# CREDIT MARKET IMPERFECTIONS

- Firms borrow at  $r$  and individuals borrow at  $i$  to invest in human capital (higher due to cost of enforcement)

$$i > r$$

It is risky to lend to individual borrowers for the purpose of investing in their human capital as they may run away without repaying the loan.

- *Potential borrowers* are individuals with less generous bequests, who borrow  $(h - b)$  to cover the shortfall Conversely,
- *Lenders* are individuals with generous bequests, who invest in their own human capital and then lend on the excess  $(b - h)$  to the potential borrowers.

# LIFETIME INCOME & BEQUESTS

- An individual who receives a bequest  $x$ , which is insufficient for human capital investment  $h$ , borrows an amount  $(h - x)$  at interest rate  $i$  to become a skilled worker. Her lifetime income is

$$m_s^{\text{borrower}} = w_s - (h - x)(1 + i) < w_s$$

- An individual who receives a sufficiently large bequest invests  $h$  in human capital and lends the rest on the capital markets at interest rate  $r$ . Her lifetime income is

$$m_s^{\text{lender}} = w_s + (x - h)(1 + r) > w_s$$

Lifetime income of an worker who remains unskilled and has a bequest of  $x$ , is

$$m_n = (x + w_n)(1 + r) + w_n$$

- Becoming a skilled worker is only lucrative if an individual has the incentive to invest  $h$  of her own funds into her human capital and forgo
  - $h(1 + r)$ , the interest she could have earned by lending  $h$  on the capital markets and
  - the lifetime income she could have earned as an unskilled worker.

- **Assumption:** Ensures that the workers would always prefer to becomes skilled if they can garner the sufficient resources.

$$w_s \geq h(1 + r) + w_n(1 + r) + w_n \tag{1}$$

# BEQUEST AMOUNTS

- Using the fact that individuals bequest a  $(1 - \alpha)$  proportion of their lifetime income, we can find the amount each group would bequest.

$$b_s^{\text{borrower}} = (1 - \alpha)[w_s - (h - x)(1 + i)]$$

$$b_s^{\text{lender}} = (1 - \alpha)[w_s + (x - h)(1 + r)]$$

$$b_n = (1 - \alpha)[(x + w_n)(1 + r) + w_n]$$

The bequest amounts determine the distribution of wealth not only in in period  $t$  but also in period  $t + 1$  after the various groups have realised their inheritances.

For a dynasty that inherits  $x_t$  in period  $t$ , the inheritance in period  $t + 1$  is given by

$$x_{t+1} \begin{cases} b_n(x_t) & x_t < f \\ b_s^{\text{borrower}}(x_t) & f \leq x_t < h \\ b_s^{\text{lender}}(x_t) & h \leq x_t \end{cases}$$

- To summarise, dynasties that inherit less than  $g$  gravitate towards  $\bar{x}_n$  and the ones that inherit more than  $g$  gravitate towards  $\bar{x}_s$ .

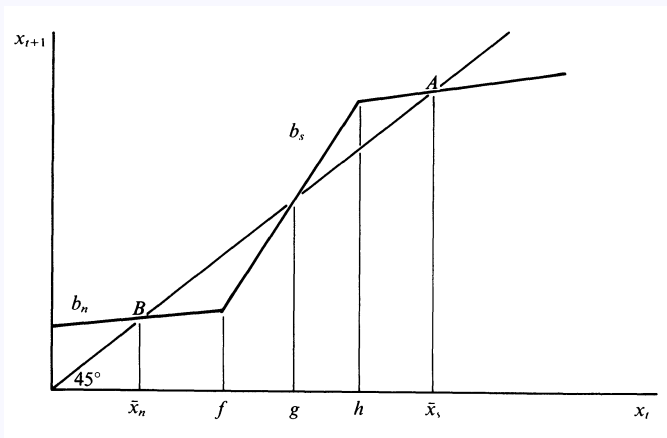


Figure: Inter-generational Wealth Dynamics

# LONG-RUN

- Off a total labour force of  $L$ , let  $L^g$  be the number of individuals who initially inherit less than  $g$  and thus  $\frac{L^g}{L}$  gives us the proportion of workers that would gravitate towards  $\bar{x}_n$ . The long run average wealth of the economy is given by

$$\left(1 - \frac{L^g}{L}\right) \bar{x}_s + \left(\frac{L^g}{L}\right) \bar{x}_n$$

which is decreasing in  $\frac{L^g}{L}$  (proportion of poor)



## IMPORTANCE OF MIDDLE-CLASS

- A poor economy with most of the people individuals with wealth below  $g$  ends up poor in the long run.
- An economy with where all wealth is concentrated in very few hands also ends up poor in the long run.
- The economy with best growth prospect is the one with a large middle-class. The long run equilibrium of the model is depends on the initial distribution of wealth in the economy.

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## GROWTH

- Assume that  $w_n$ , productivity in the non-skilled sector grows that at rate  $\alpha_n$  and  $w_s$  and  $h$ , productivity in skilled sector grows at  $\alpha_s$ .
- The rate of growth of output per capita is a weighted average of  $\alpha_n$  and  $\alpha_s$ , where the weights depend on initial distribution of wealth.
  - Wealth distribution can affect non only the long run level of output but also the rate of growth

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## POLICY

1. Lowering the cost of monitoring the borrowers
2. Subsidising education
  - shifts the  $b_s$  curve to the left lowering both the values of  $f$  and  $g$  and increasing the invest and output in short and long run
  - Pareto improvement if the debt collection costs are higher than cost of tax collections
- 2.1 government avoids the need to keep track of each individual borrower by giving subsidy to all students and taxing everyone with high income with no need to know how much each individual borrows
- 2.2 Tax system already exists and so no fixed cost associated with starting a new tax collection system

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## SUMMARY

- Analyses the role of income distribution on growth through the human capital channel
- With capital market imperfections, distribution of wealth significantly affects the aggregate economic activity
- Indivisibility of investment in human capital ensures that this affects long run as well

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## POSITIVE EXTERNAL ECONOMIES

Increasing interest in economic models with positive external economies

- Romer (1986a, 1986b) has shown that external economies may remove the traditional distinction between *factor accumulation* and *technical change* as a source of growth
- Murphy, Shleifer & Vishny (1989) – *market size effects* create external economies among firms investing in industrialisation and thus offer a rigorous formulation of Rosenstein-Rodan’s (1943) “*big push*” theory of economic development
- Krugman (1981,1987) – use external economies to formulate the “*uneven development*” model in which division of the world into rich and poor takes place endogenously and historical accidents get locked in through learning effects

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## EXTERNAL ECONOMIES

External Economies → multiple equilibria  
*with external economies, the return from committing resources to some activity is higher, the greater the resources committed.*

- Krugman (1987) – the rate of learning in a sector is larger the larger the sector is
- Adserà & Ray (1998) – returns of capital in the modern sector is higher, the more capital is invested in modern sector

The reason why capital may move to a currently unfavoured sector, despite the lag in realisation of externalises, is because a latter move will involve a higher cost.

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## EXTERNAL ECONOMIES

In the increasing returns and externality literature, multiple equilibria is central part of the story

Once the multiple equilibria has been established, the question is which equilibrium would actually be reached?

A View: Choice amongst the multiple equilibria is resolved by *history*

- Backward looking dynamics

A Contrary View: Equilibria is resolved by *expectations*

- Forward looking dynamics
- Self-fulfilling prophecy

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